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**APPENDIX G-4**

**FUGITIVE DUST EMISSION ESTIMATES**



***APPENDIX G4: FUGITIVE DUST EMISSION ESTIMATES***

This appendix provides a summary of fugitive dust emissions that would be generated by military vehicle travel on unpaved roads or on unpaved vehicle maneuver areas under all project alternatives. Emission estimates are presented for travel on gravel roads, dirt roads, and off-road maneuver areas at each installation under each alternative. The summarized emission estimates are based on current AP-42 procedures (EPA 1998). Vehicle use assumptions (consistent with those used for Appendix G3) also are presented.

The detailed spreadsheets documenting the emission calculations generally do not lend themselves to hard copy printing. Electronic versions of the spreadsheets can be made available on request.

# SUMMARY OF ESTIMATED PM10 EMISSIONS FROM MILITARY VEHICLE TRAVEL ON UNPAVED AREAS

LOCATION	TRAFFIC AREA	NO ACTION		PROPOSED ACTION			REDUCED LAND ACQUISITION		
		ESTIMATED ANNUAL VMT	ANNUAL PM10, TONS/YEAR	ESTIMATED ANNUAL VMT	ANNUAL PM10, TONS/YEAR	NET CHANGE, PM10 TONS/YEAR	ESTIMATED ANNUAL VMT	ANNUAL PM10, TONS/YEAR	NET CHANGE, PM10 TONS/YEAR
Schofield Barracks Main Post	Gravel Roads	165,436	170.74	240,351	295.28	124.54	240,351	295.28	124.54
	Dirt Roads	56,399	162.19	81,938	280.49	118.30	81,938	280.49	118.30
	Off-Road Areas	41,279	52.26	67,497	103.34	51.08	67,497	148.71	96.45
	<b>TOTAL</b>	<b>263,114</b>	<b>385.18</b>	<b>389,786</b>	<b>679.11</b>	<b>293.92</b>	<b>389,786</b>	<b>724.48</b>	<b>339.29</b>
Schofield Barracks East Range	Gravel Roads	110,291	172.13	160,234	297.68	125.55	160,234	297.68	125.55
	Dirt Roads	37,599	163.50	54,625	282.77	119.26	54,625	282.77	119.26
	Off-Road Areas	96,319	139.17	157,494	380.81	241.63	157,494	380.81	241.63
	<b>TOTAL</b>	<b>244,208</b>	<b>474.80</b>	<b>372,353</b>	<b>961.25</b>	<b>486.45</b>	<b>372,353</b>	<b>961.25</b>	<b>486.45</b>
<b>SCHOFIELD SUBTOTAL</b>	Gravel Roads	275,727	342.86	400,585	592.96	250.09	400,585	592.96	250.09
	Dirt Roads	93,998	325.69	136,563	563.25	237.56	136,563	563.25	237.56
	Off-Road Areas	137,598	191.43	224,991	484.15	292.72	224,991	529.52	338.09
	<b>TOTAL</b>	<b>507,323</b>	<b>859.99</b>	<b>762,139</b>	<b>1,640.36</b>	<b>780.37</b>	<b>762,139</b>	<b>1,685.73</b>	<b>825.74</b>
Dillingham Military Reservation	Gravel Roads	53,876	62.72	62,702	86.89	24.17	62,702	86.89	24.17
	Dirt Roads	18,367	59.58	21,376	82.54	22.96	21,376	82.54	22.96
	Off-Road Areas	181,340	204.03	223,069	367.50	163.48	223,069	367.50	163.48
	<b>TOTAL</b>	<b>253,582</b>	<b>326.33</b>	<b>307,146</b>	<b>536.94</b>	<b>210.61</b>	<b>307,146</b>	<b>536.94</b>	<b>210.61</b>
Kahuku Training Area	Gravel Roads	36,733	42.77	54,302	75.25	32.49	54,302	75.25	32.49
	Dirt Roads	12,523	40.62	18,512	71.48	30.86	18,512	71.48	30.86
	Off-Road Areas	123,641	77.31	233,838	329.18	251.87	233,838	329.18	251.87
	<b>TOTAL</b>	<b>172,897</b>	<b>160.70</b>	<b>306,651</b>	<b>475.91</b>	<b>315.22</b>	<b>306,651</b>	<b>475.91</b>	<b>315.22</b>
<b>O'AHU SUBTOTAL</b>	Gravel Roads	366,336	448.35	517,588	755.11	306.75	517,588	755.11	306.75
	Dirt Roads	124,887	425.89	176,451	717.28	291.39	176,451	717.28	291.39
	Off-Road Areas	442,579	472.77	681,898	1,180.83	708.06	681,898	1,226.20	753.43
	<b>TOTAL</b>	<b>933,802</b>	<b>1,347.01</b>	<b>1,375,936</b>	<b>2,653.21</b>	<b>1,306.20</b>	<b>1,375,936</b>	<b>2,698.58</b>	<b>1,351.57</b>
Pahukaloa Training Area	Gravel Roads	169,621	344.78	250,049	605.02	260.24	250,049	605.02	260.24
	Dirt Roads	57,825	153.84	85,244	269.97	116.12	85,244	269.97	116.12
	Off-Road Areas	349,727	299.63	661,427	352.71	53.07	661,427	352.71	53.07
	<b>TOTAL</b>	<b>577,173</b>	<b>798.25</b>	<b>996,720</b>	<b>1,227.69</b>	<b>429.44</b>	<b>996,720</b>	<b>1,227.69</b>	<b>429.44</b>
<b>GRAND TOTAL</b>	Gravel Roads	535,957	793.13	767,637	1,360.13	567.00	767,637	1,360.13	567.00
	Dirt Roads	182,713	579.74	261,694	987.25	407.51	261,694	987.25	407.51
	Off-Road Areas	792,306	772.40	1,343,324	1,533.54	761.13	1,343,324	1,578.90	806.50
	<b>TOTAL</b>	<b>1,510,976</b>	<b>2,145.27</b>	<b>2,372,656</b>	<b>3,880.91</b>	<b>1,735.64</b>	<b>2,372,656</b>	<b>3,926.28</b>	<b>1,781.01</b>

## Notes:

Fugitive dust calculations are based on the current EPA AP-42 Section 13.2.2 (1998 equation version), including the low speed adjustment factor. Vegetation cover is used as a linear correction factor for vehicle activity in off-road areas.

## Source:

U.S. Environmental Protection Agency. 1998. Compilation of Air Pollutant Emission Factors (AP-42) 5th Edition, Volume I, Supplement E, Section 13.2.2 (Unpaved Roads).

## EPA FUGITIVE DUST EQUATIONS FOR UNPAVED ROADS

gallons/liter = 0.264172052  
grams/pound = 453.5923745  
mile/kilometer = 0.621371192

### FUGITIVE DUST FROM UNPAVED AREAS:

Five alternative equations are available for estimating fugitive PM10 from vehicle use on unpaved areas (unpaved roads, tank trails, or off-road areas):

Emission rate equation in AP-42 Fifth Edition, Volume I, Section 13.2.2 (EPA 1995):

$$\text{PM10 tons/day} = 0.36 \times 5.9 \times [(\% \text{silt} + \text{clay}) / 12] \times (\text{mph} / 30) \times [(\text{tons GVW} / 3)^{(0.7)}] \times [(\# \text{wheels} / 4)^{(0.5)}] \times [(365 - \text{precip days}) / 365] \times (\text{VMT/day}) / (2000 \text{ lbs/ton})$$

Emission rate equation in AP-42 Fifth Edition, Volume I, Supplement E, Section 13.2.2 (EPA 1998):

$$\text{PM10 tons/day} = 2.6 \times [((\% \text{silt} + \text{clay}) / 12)^{(0.8)}] \times [(\text{mean vehicle weight in tons} / 3)^{(0.4)}] \times [(365 - \text{precip days}) / 365] \times (\text{VMT/day}) / [((\text{surface moisture} \% / 0.2)^{(0.3)}) \times (2000 \text{ lbs/ton})]$$

where "mean vehicle weight in tons" is a weighted average of all vehicle traffic on a particular road segment or off-road area.

Note: this equation overpredicts emissions at speeds below 15 mph. An optional multiplier of (mean vehicle speed)/15 can be used as a correction factor.

Emission rate equation A in proposed revision to AP-42 Fifth Edition, Volume I, Section 13.2.2 (EPA 2001):

$$\text{PM10 tons/day} = 1.5 \times [((\% \text{silt} + \text{clay}) / 12)^{(0.9)}] \times [(\text{mean vehicle weight in tons} / 3)^{(0.45)}] \times [(365 - \text{precip days}) / 365] \times (\text{VMT/day}) / (2000 \text{ lbs/ton})$$

where "mean vehicle weight in tons" is a weighted average of all vehicle traffic on a particular road segment or off-road area.

Emission rate equation B Option 1 in proposed revision to AP-42 Fifth Edition, Volume I, Section 13.2.2 (EPA 2001):

$$\text{PM10 tons/day} = 1.8 \times [(\% \text{silt} + \text{clay}) / 12] \times [(\text{mean vehicle speed in mph} / 30)^{(0.5)}] \times [(365 - \text{precip days}) / 365] \times (\text{VMT/day}) / [((\text{surface moisture} \% / 0.5)^{(0.2)}) \times (2000 \text{ lbs/ton})]$$

where "mean vehicle speed in mph" is a weighted average of all vehicle traffic on a particular road segment or off-road area.

Emission rate equation B Option 2 in proposed revision to AP-42 Fifth Edition, Volume I, Section 13.2.2 (EPA 2001):

$$\text{PM10 tons/day} = 1.7 \times [((\% \text{silt} + \text{clay}) / 12)^{(0.8)}] \times [(\text{mean vehicle speed in mph} / 30)] \times [(365 - \text{precip days}) / 365] \times (\text{VMT/day}) / [((\text{surface moisture} \% / 0.5)^{(0.2)}) \times (2000 \text{ lbs/ton})]$$

where "mean vehicle speed in mph" is a weighted average of all vehicle traffic on a particular road segment or off-road area.

### NOTE:

When any of the above equations are applied to off-road vehicle activity that is not on established trails, the percent vegetation cover can be used as an additional linear control factor. The multiplier factor would be (1-vegetation cover fraction).

**SUMMARY OF MILITARY VEHICLE DRIVING ESTIMATES**  
**PAVED ROADS, UNPAVED ROADS, AND OFF-ROAD AREAS**

**PAVED ROAD TRAVEL ANALYSIS**

ALTERNATIVE	NOMINAL LOCATION	CUMULATIVE VEH-HOURS	PERCENT OF TOTAL
PROPOSED ACTION	SCHOFIELD	8,292	60.00%
	DMR	2,030	14.69%
	KTA	1,225	8.86%
	<b>SUBTOTAL</b>	<b>11,546</b>	<b>83.55%</b>
	PTA	2,274	16.45%
	<b>TOTAL</b>	<b>13,820</b>	<b>100.00%</b>
REDUCED LAND ACQUISITION	SCHOFIELD	8,292	60.00%
	DMR	2,030	14.69%
	KTA	1,225	8.86%
	<b>SUBTOTAL</b>	<b>11,546</b>	<b>83.55%</b>
	PTA	2,274	16.45%
	<b>TOTAL</b>	<b>13,820</b>	<b>100.00%</b>
NO ACTION	SCHOFIELD	5,863	59.13%
	DMR	1,642	16.56%
	KTA	704	7.10%
	<b>SUBTOTAL</b>	<b>8,208</b>	<b>82.78%</b>
	PTA	1,707	17.22%
	<b>TOTAL</b>	<b>9,916</b>	<b>100.00%</b>

Notes:

Vehicle idling time for paved road travel set at 5% of the cumulative driving time.

Vehicle load conditions for Strykers and HMMWVs set at 75% intermediate and 25% maximum.

Vehicle load conditions for trucks set at 50% empty, 40% loaded, 10% max load.

#### UNPAVED ROAD TRAVEL ANALYSIS

ALTERNATIVE	NOMINAL LOCATION	CUMULATIVE VEH-HOURS	PERCENT OF TOTAL
PROPOSED ACTION	SCHOFIELD	27,313	52.18%
	DMR	4,275	8.17%
	KTA	3,702	7.07%
	<b>SUBTOTAL</b>	<b>35,290</b>	<b>67.43%</b>
	PTA	17,049	32.57%
	<b>TOTAL</b>	<b>52,339</b>	<b>100.00%</b>
REDUCED LAND ACQUISITION	SCHOFIELD	27,313	52.18%
	DMR	4,275	8.17%
	KTA	3,702	7.07%
	<b>SUBTOTAL</b>	<b>35,290</b>	<b>67.43%</b>
	PTA	17,049	32.57%
	<b>TOTAL</b>	<b>52,339</b>	<b>100.00%</b>
NO ACTION	SCHOFIELD	18,800	51.45%
	DMR	3,673	10.05%
	KTA	2,505	6.85%
	<b>SUBTOTAL</b>	<b>24,977</b>	<b>68.35%</b>
	PTA	11,565	31.65%
	<b>TOTAL</b>	<b>36,543</b>	<b>100.00%</b>

Notes:

Vehicle idling time for unpaved road travel set at 15% of the cumulative driving time.

Vehicle load conditions for Strykers and HMMWVs set at 75% intermediate and 25% maximum.

Vehicle load conditions for trucks set at 50% empty, 40% loaded, 10% max load.

#### OFF-ROAD TRAVEL ANALYSIS

ALTERNATIVE	NOMINAL LOCATION	CUMULATIVE VEH-HOURS	PERCENT OF TOTAL
PROPOSED ACTION	SCHOFIELD	18,749	16.75%
	DMR	18,589	16.61%
	KTA	19,486	17.41%
	<b>SUBTOTAL</b>	<b>56,825</b>	<b>50.76%</b>
	PTA	55,119	49.24%
	<b>TOTAL</b>	<b>111,944</b>	<b>100.00%</b>
REDUCED LAND ACQUISITION	SCHOFIELD	18,749	16.75%
	DMR	18,589	16.61%
	KTA	19,486	17.41%
	<b>SUBTOTAL</b>	<b>56,825</b>	<b>50.76%</b>
	PTA	55,119	49.24%
	<b>TOTAL</b>	<b>111,944</b>	<b>100.00%</b>
NO ACTION	SCHOFIELD	11,466	17.37%
	DMR	15,112	22.89%
	KTA	10,303	15.61%
	<b>SUBTOTAL</b>	<b>36,882</b>	<b>55.86%</b>
	PTA	29,144	44.14%
	<b>TOTAL</b>	<b>66,025</b>	<b>100.00%</b>

Notes:

Vehicle idling time for off-road travel set at twice the cumulative driving time.

Vehicle load conditions for Strykers and HMMWVs set at 75% intermediate and 25% maximum.

Vehicle load conditions for trucks set at 50% empty, 40% loaded, 10% max load.

**GRAND TOTALS**

ALTERNATIVE	NOMINAL LOCATION	CUMULATIVE VEH-HOURS	PERCENT OF TOTAL
PROPOSED ACTION	SCHOFIELD	54,354	30.52%
	DMR	24,894	13.98%
	KTA	24,414	13.71%
	<b>SUBTOTAL</b>	<b>103,661</b>	<b>58.20%</b>
	PTA	74,441	41.80%
	<b>TOTAL</b>	<b>178,103</b>	<b>100.00%</b>
REDUCED LAND ACQUISITION	SCHOFIELD	54,354	30.52%
	DMR	24,894	13.98%
	KTA	24,414	13.71%
	<b>SUBTOTAL</b>	<b>103,661</b>	<b>58.20%</b>
	PTA	74,441	41.80%
	<b>TOTAL</b>	<b>178,103</b>	<b>100.00%</b>
NO ACTION	SCHOFIELD	36,129	32.12%
	DMR	20,427	18.16%
	KTA	13,512	12.01%
	<b>SUBTOTAL</b>	<b>70,068</b>	<b>62.29%</b>
	PTA	42,416	37.71%
	<b>TOTAL</b>	<b>112,484</b>	<b>100.00%</b>
NET CHANGE FOR SBCT	SCHOFIELD	18,224	27.77%
	DMR	4,467	6.81%
	KTA	10,902	16.61%
	<b>SUBTOTAL</b>	<b>33,594</b>	<b>51.20%</b>
	PTA	32,025	48.80%
	<b>TOTAL</b>	<b>65,619</b>	<b>100.00%</b>

**VEHICLE MILEAGE ASSUMPTIONS, NO ACTION:**

VEHICLE TYPE	NUMBER OF VEHICLES	ANNUAL USE DAYS PER VEH	PER VEHICLE MILES/USE-DAY	ASSUMED MI/YR/VEH	% VMT BY VEH TYPE
STRYKER	0	150	10	1,500	0.00%
HMMWV	460	180	12	2,160	78.90%
LMTV	90	175	8	1,400	10.01%
MTV	70	145	8	1,160	6.45%
HEMTT	25	60	25	1,500	2.98%
PLS, HET	14	50	30	1,500	1.67%
<b>TOTALS</b>	<b>659</b>	<b>168</b>	<b>11</b>	<b>1,911</b>	<b>100.00%</b>



**VEHICLE MILEAGE ASSUMPTIONS, PROPOSED ACTION AND REDUCED LAND ACQUISITION:**

<b>VEHICLE TYPE</b>	<b>NUMBER OF VEHICLES</b>	<b>ANNUAL USE DAYS PER VEH</b>	<b>PER VEHICLE MILES/USE-DAY</b>	<b>ASSUMED MI/YR/VEH</b>	<b>% VMT BY VEH TYPE</b>
STRYKER	296	150	10	1,500	24.24%
HMMWV	490	185	12	2,220	59.39%
LMTV	105	180	8	1,440	8.26%
MTV	75	150	8	1,200	4.91%
HEMTT	25	60	25	1,500	2.05%
PLS, HET	14	50	30	1,500	1.15%
<b>TOTALS</b>	<b>1,005</b>	<b>167</b>	<b>11</b>	<b>1,822</b>	<b>100.00%</b>

## Notes:

HMMWV = high mobility multipurpose wheeled vehicle (humvee)

LMTV = light medium tactical vehicle (2.5 ton truck)

MTV = medium tactical vehicle (5 ton truck)

HEMTT = heavy expanded mobility tactical truck (10 ton truck)

PLS = palletized load system truck (25+ ton capacity)

HET = heavy equipment transporter (60+ ton capacity)

The high-low range of vehicle requirement estimates for individual range facilities yield fleet-wide annual average vehicle use values ranging from 37 to 301 use-days per year per vehicle.

The use estimates assumed above yield a fleet-wide weighted annual average slightly below the 169 use-day per vehicle mid-point value.

Stryker mileage split 50% on roadways, 50% off-road. Roadway type split 25% paved roads, 75% unpaved roads.

HMMWV mileage split 2/3 on roadways, 1/3 off-road. Roadway type split 50% paved roads, 50% unpaved roads.

LMTV and MTV mileage split 75% on roadways, 25% off-road. Roadway type split 50% paved roads, 50% unpaved roads.

HEMTT, PLS, and HET heavy truck mileage split 75% on roadways, 25% off-road. Roadway type split 75% paved roads, 25% unpaved roads.